Psychology & Health, 2018
Vol. 33, No. 1, 58–76, https://doi.org/10.1080/08870446.2017.1314478

Emotional processes in risky and multiattribute health decisions

Stephanie M. Carpenter* and Paula M. Niedenthal

Department of Psychology, University of Wisconsin-Madison, Madison, WI, USA

(*Received 16 October 2016; accepted 28 March 2017*)

Objective: Here, we develop an integrative account of the roles of emotion in decision-making. In Part I, we illustrate how emotional inputs into decisions may rely on physiological signals from emotions experienced while making the decision, and we review evidence suggesting that the failure to represent the emotional meaning of options can often reduce decision quality. We propose that health-related decrements in the ability to generate emotional reactions lead people to inaccurately represent emotional responses and compromise decisions, particularly about risk. Part II explores complex decisions in which choice options involve trade-offs between positive and negative attributes. We first review evidence showing that difficult trade-off decisions generate negative affect and physiological arousal. Next, we propose that medical decision-making will be linked to short- and long-term stress and health outcomes.
Conclusion: In sum, this article proposes and reviews initial evidence supporting the effective use and management of emotional inputs as important to both clinical and non-clinical populations. Our approach will contribute to the understanding of patient-centred emotional decision-making and will inform medical decision aids.

Keywords: emotion; decision-making; risk; health

Introduction

The subjective experience of emotion is derived from a pattern of different physiological inputs (i.e. sympathetic nervous system activation, parasympathetic nervous system activation, facial expressions and body posture, among others). Effectively using and managing these components of emotion is important for navigating daily life. This may become especially critical when an important or difficult decision entails choosing among options that have emotional outcomes or when the choice elicits negative affect that could disrupt the individual's decision-making process. The ability to use and manage emotions is thus critical when people make consequential and difficult life decisions.

Health decisions are nearly always consequential and difficult. Virtually every person is faced with important health decisions at some point during their lifetime. Moreover, such decisions tend to involve risk assessments and/or complicated trade-offs, and can be a source of stress for the decision-maker. When making difficult decisions, we propose that having the ability to effectively use emotion responses as feedback signals

*Corresponding author. Email: scarpenter3@wisc.edu

for a decision, and at the same time manage disruptive physiological arousal and stress, results in more effective decision-making.

In the present theoretical paper, we first review extant research on the challenges that patients face when making health decisions. We then illustrate how emotional inputs can be both helpful and detrimental to the decision process, and propose that the use and management of emotions across different physiological inputs predictably influences the way that decisions are made. In proposing these linkages, we seek to outline new ways to think about and test the interplay between patient emotions and complex decision processes.

Background on patient decision-making

When patients make decisions, they rarely do so in the absence of emotion. Many health-related decisions are perceived to be difficult because imagining taking the actions involved in the choice options is associated with emotional responses. Some medical treatment options, for instance, involve engaging in behaviours that are uncomfortable or even frightening. Other complex health-related decisions involve a choice among alternatives that are characterised by many attributes. In such 'multiattribute decisions', the alternatives in the decision contain attributes that are in conflict with each other; some attributes that are positive in one choice option are negative in the other choice option, and vice versa. For example, a patient who suffers from a commonplace medical condition known as Crohn's disease – an inflammatory condition of the gastrointestinal system – might be faced with the decision of whether to undergo biologic therapy vs. non-biologic therapy. Biologic therapies are more effective at treating Crohn's disease (a positive attribute), but are invasive and likely to suppress the patient's immune system, which puts the patient at a greater risk for infections and cancer (a negative attribute). Non-biologic therapies are less effective at treating the Crohn's disease (a negative attribute), but are also less likely to suppress the patient's immune system (a positive attribute). Thus, the trade-off for the patient is between the effectiveness of the treatment for Crohn's disease vs. the risks of side effects from immune suppression. Whichever option the patient chooses he or she will be faced with accepting either a higher likelihood of undesirable side effects or a less effective treatment.

Psychological research on patient decision-making has illuminated challenges and biases in health decision-making. Difficulties in such decisions are due to a variety of factors, including affective forecasting errors, the influence that specific emotions have on decision-making, individual differences in numeracy, challenges with cost-benefit analyses and susceptibility to message framing. Research has also revealed ways to improve patient decision-making by identifying discrepancies in self-other decisions, examining difficulties that patients may have with understanding and using decision aids, and by evaluating shared decision-making processes that occur between health care providers and patients. We briefly summarise the extant findings.

Challenges to patient decision-making

A focus on the interplay between emotion and decision-making is relatively recent in the field of decision science (Lerner, Li, Valdesolo, & Kassam, 2015). One important line of research has examined decisions that involve anticipating a future emotional

state. Research on this process, also called affective forecasting, has demonstrated that people do a poor job of predicting future emotional states (Wilson & Gilbert, 2005). They are typically unable to forecast their future well-being, and also mispredict the emotional impact of important life changes, including chronic illnesses and disabilities, on their day-to-day lives (cf. Ubel, Loewenstein, Schwarz, & Smith, 2005). Poor predictions occur because, in general, people underestimate their own adaptability to major life changes, and forecast decreased life-satisfaction and well-being if they can imagine that the change has the potential to involve some negative outcome. Not surprisingly, biased affective forecasting often results in suboptimal decision-making (Gilbert & Ebert, 2002; Hsee & Hastie, 2006; Ubel et al., 2005).

In addition to the effects that anticipating a general positive or negative emotion state exert on decision-making, specific emotions also differentially influence behaviour (Smith & Ellsworth, 1985), including decision-making and risk perception (Lerner & Keltner, 2001). Emotion appraisal theories, such as the Appraisal-Tendency Framework (ATF; Lerner & Keltner, 2001), have pinpointed the cognitive appraisals that accompany specific emotions. The appraisals include perceptions of how much certainty and control an individual believes that he or she has in a given environment or situation (Lerner & Keltner, 2001; Smith & Ellsworth, 1985). Appraisals of certainty and control, for example, lead people experiencing fear (a low personal control, low certainty emotion) to generate more pessimistic risk estimates and make more risk-averse choices, relative to people experiencing anger (a high personal control, high certainty emotion) who tend toward more optimistic risk estimates and more risk-seeking choices (Lerner & Keltner, 2001). The appraisals associated with specific emotions can thus determine the course of risky decision-making, including choices among health decisions that involve treatment and side effect risks.

Other research has shown a connection between people's 'numeracy', or the ability to derive meaningful information from numbers, and their comfort with decisions that involve mathematical information, including probabilities (Malloy-Weir, Schwartz, Yost, & McKibbon, 2016; Peters et al., 2006). Health decisions often involve complicated numerical information, including the probability of a treatment being effective. Extant research shows that individuals high in numeracy are able to use feelings derived from the assessment of numerical information to make more effective decisions (Peters et al., 2006). Individuals low in numeracy, on the other hand, struggle to derive meaning from numerical information and often misunderstand or altogether avoid using numbers in their decision-making. For example, compared to people higher in numeracy, less numerate people are more influenced by affective information that is irrelevant to the decision (e.g. will choose to select a bean from a bowl of jelly beans that has a greater absolute number of beans, even when the other bowl option has a higher probability of winning). This research also suggests that individual differences in numeracy similarly alter how patients make health decisions involving numerical information and can lead less numerate people to struggle more with complex tasks, such as comprehending the likelihood of risks and benefits in different health care options (Peters, Hibbard, Slovic, & Dieckmann, 2007).

Numeracy is just one way in which the fluency of processing medical information is important to patient decision-making. Processing fluency is defined as the ease with which people are able to encode novel information (Winkielman, Schwarz, Fazendeiro, & Reber, 2003). Information encoded more fluently (e.g. easier to read font) is

perceived as easier to understand, whereas more disfluent information (e.g. harder to read font) tends to be perceived as more difficult to understand (cf. Novemsky, Dhar, Schwarz, & Simonson, 2007; Song & Schwarz, 2008). Disfluent information can have either positive or negative consequences for judgement and decision-making. For instance, disfluent information can lead people to overcome heuristic biases such as detecting semantic distortions (Song & Schwarz, 2008). Disfluent information, however, can also lead people to defer making decisions (Novemsky et al., 2007) or to rely excessively on the advice of others who may not have a complete understanding of the patient's interests or desires.

As described above, multiattribute decisions are choice problems that involve trade-offs between positive and negative attributes. The trade-offs are sometimes resolved through weighing the subjective benefits and costs inherent in the decision. During this process of weighing the subjective costs and benefits the person may come to the realisation that regardless of what choice is made he or she will be foregoing some desired positive feature(s), as well as accepting some undesired negative feature(s). The conflict between positive and negative attributes can cause people to experience negative feelings (Carpenter, Yates, Preston, & Chen, 2016). There is evidence that individuals' subjective importance weights (e.g. the importance given to an attribute in a decision option) predict patient action or inaction in health decision contexts (Singer et al., 2014). These subjective importance weights, unfortunately, do not necessarily indicate that the patient is well informed or knowledgeable about the decision being made. This research also suggests that a patient can state the subjective importance of some attribute in a decision context, but this does not mean that the patient actually understands the objective facts of the decision. Moreover, Singer et al. (2014) indicated that when the difference between the self-reported importance attached to the benefits and costs in a decision context was greater, this led to the patient self-reporting more confidence in his or her decision. The increased confidence was observed regardless of whether the patient's subjective weights had any bearing on objective facts in the decision, suggesting that patient perceptions of the importance of costs and benefits in a health decision context may override actual facts about the decision options. Given that subjective evaluations drive behaviour even in the absence of objective factual information (Singer et al., 2014), people's subjective importance weights and subsequent choices may be particularly susceptible to extraneous information, including the experience of negative feeling states.

Message framing has traditionally also been important to the decision process (cf. Kahneman & Tversky, 1979, 1984), and has strong implications for patient decisions. The effects of message framing have been typically studied in the context of gain and loss frames. A message is considered to be in a 'gain frame' when an outcome is portrayed in terms of benefits (e.g. number of lives *saved*), whereas a 'loss frame' describes when that outcome is portrayed in terms of costs (e.g. number of lives *lost*). Research indicates that framing a message as a gain vs. a loss can reverse the direction of the decision by changing the information that people attend to (cf. Kahneman & Tversky, 1979). For instance, people viewing a loss frame involving lives lost will attend more to the sure losses incurred from a specific decision and consequently become more risk seeking. Those in the gain frame, on the other hand, will focus instead on how many lives will be saved and tend to become more risk averse (Kahneman & Tversky, 1984). In addition, gain-framed persuasion appeals are more

effective when they target behaviours that prevent the onset of some disease, whereas loss-framed appeals are more effective when targeting behaviours that detect the presence of an existing disease (Rothman, Bartels, Wlaschin, & Salovey, 2006). This suggests that the framing of health information critically depends on whether the health decision is about prevention or detection of a health condition.

Efforts to improve patient decision-making

In addition to the biased attention that stress and other emotional responses introduce into decision-making, extant research efforts have also examined ways to improve patient decisions. For example, there are differences in decisions made for the self vs. for another person (Zikmund-Fisher, Fagerlin, & Ubel, 2006). Preferences for active survival-maximising treatments, for instance, are stronger when participants imagine themselves in a medical professional role, than when they imagine themselves as a patient. Specifically, when imagining oneself as a medical professional making a treatment decision for another patient(s), a person is more likely to select the active chemotherapy or flu vaccine options which would maximise survival rates, but may also have an increased risk of side effects. When deciding for themselves, however, people are more likely to select the passive no-treatment options with the lowered risk of side effects (Zikmund-Fisher, Sarr, Fagerlin, & Ubel, 2006). This suggests that certain roles or mindsets adopted by patients and medical professionals can lead to differences in how people make difficult health decisions involving risk.

Similarly, decision aiding is an important topic for patient decision-making (Peters et al., 2007; Yates, Veinott, & Patalano, 2003). A decision aid is any technique or device that is intended to assist the person in making a more effective and/or better quality decision (Yates et al., 2003). Research on decision aiding suggests that a number of different procedures exist that intend to help guide patients through a decision (Yates et al., 2003). These aids range from guided cost-benefit analysis tools to numerical information presented in probabilistic formats, to visual displays and graphics, among other tools (Peters et al., 2007; Yates et al., 2003). Yet, despite ongoing research efforts on decision aiding, challenges associated with effective aiding procedures still exist. A recent review (Engelen, Vanderhaegen, Van Poppel, & Van Audenhove, 2016) suggests that although patients express a desire to and need to receive support through decision aiding procedures, they encounter barriers to using the provided tools. This is especially likely to occur when patients perceive that the decision-aiding tool is too difficult to use, and when patients doubt the effectiveness of the tool.

A related topic of growing importance is shared decision-making between patients and physicians. Although patients have traditionally trusted health decisions primarily to their physicians, recent research has been dedicated to encouraging patients to take an active role in their health decisions (Zikmund-Fisher et al., 2006). Shared decision-making in the context of health matters because patients are the ones who have to live with the consequences of the health decisions that they make. It is thus crucial that patients make decisions that lead to the best possible daily outcomes. Being faced with difficult decisions that are consequential for real health outcomes can be stressful, particularly if the best choice is not obvious. Investigations of shared decision-making (cf. Lin & Fagerlin, 2014) demonstrate that patients are typically misinformed about the risks and benefits associated with treatments and frequently have little involvement in

the actual decision-making process. Consequently, a goal of shared decision-making is to aid patients in making informed, evidence-based decisions, that might prevent them from falling prey to the problem of making subjective decisions with high confidence that have no bearing in actual objective facts. This approach will presumably lead to a more effective and satisfying decision process. Shared decision-making interventions have improved patients' understanding of the available treatment options, aided in the formation of realistic expectations about benefits and harms, increased patient involvement in the decision process, and increased the degree of agreement between patients' stated values and their treatment decisions (Lin & Fagerlin, 2014). Through these improvements, shared decision-making can help patients make decisions that align with their values in ways that reduce the disruptive negative affect experienced during the decision process, and consequently increases patients' well-being and satisfaction with their health outcomes.

Our brief review of extant research, while by no means comprehensive, suggests that emotions influence patient decision-making at all points in the decision process and in both fine-grained and more global ways. Health decisions often involve risk and difficult trade-offs and so we propose that they provide a context in which emotional reactions, including stress reactivity, are especially likely to occur. Further, medical conditions also affect the input of emotional information that patients need in order to make effective decisions. There are, for example, neurological and muscular disorders, including Bell's Palsy, Parkinson's Disease, Ramsay-Hunt Syndrome, Multiple Sclerosis, Guillain-Barré syndrome, stroke, injuries and advanced diabetes, which are all associated with compromised emotional inputs, and have important and predictable consequences for patient decision-making. Thus, challenges are presented not only because health decisions are difficult, but also because symptoms themselves can have a detrimental effect on emotion processing. Consequently, we argue that it is important to take a patient-centred approach to investigating the influence of emotional inputs on the decision process, with a special focus on how patients use and manage emotional inputs in order to make decisions. This is the aim of the remainder of our article.

Effectively using emotional inputs in the decision-making process

We propose that the effective use and management of emotions across different physiological inputs systematically influences the way that decisions are made. Not only is it important for individuals to use the emotions associated with choice options to make better decisions, but individuals must also manage their emotions so that they are not too overwhelmed by the decision process itself.

The theoretical portion of the paper is divided into two related sections. In Part I, we illustrate the ways in which emotional reactions are used to guide the decision-making process. In this section, we bring together findings and ideas from other areas of social and emotion psychology to show that using emotional responses (particularly feedback from bodily expressions of emotion) provides important information for decision-making. In Part II, we review accounts of how sympathetic nervous system and cardiovascular reactions to stress influence decisions. We explore, in particular, the problem of choices among options that involve difficult multiattribute trade-offs. In such cases, we suggest, the stress generated by the difficulty of the decision problem can

disrupt the decision process. When the decision process is disrupted, the individual may not be able to effectively make the decision, and may experience greater dissatisfaction with both the process and with the choice outcomes. Thus, our argument focuses on how the management of emotional inputs during the decision process influences patients' decisions.

Part I: emotional inputs to patient decision-making

We use the term emotional inputs to mean any signal to the system that indicates, either consciously or non-consciously, the presence of an emotional response. Such inputs include physiological signals from sympathetic nervous system activation, parasympathetic nervous system activation, cardiovascular reactions, facial expressions and body posture (cf. Castellano, Kessous, & Caridakis, 2008; Damasio, Everitt, & Bishop, 1996; Ekman, 2004). Extant literature suggests that emotional inputs play an important role in judgments and decisions, and we review an existing account relevant to this point and make novel proposals about how patients use physiological inputs when making decisions. Here, we are most interested in immediate 'action-related' emotions, which are a type of emotion integral to the decision, and involve behaviours that take place during the decision-making process (cf. Schlösser, Dunning, & Fetchenhauer, 2013; Schlosser, Fetchenhauer, & Dunning, 2014). For example, deciding to jump off a high cliff into a pool of water for recreation involves the risk of being injured. But the act of jumping also elicits emotion. Feelings provoked by considering jumping off a cliff can be useful because they regulate risky behaviour, many times in effective ways (Dunning, Fetchenhauer, & Schlosser, 2017). For instance, if a person has already jumped off the same cliff before, and knows that the experience of jumping is both exhilarating and safe, this is a useful positive emotion that will move the decision to jump off of the cliff forward. If one has never done so, however, any fear experienced during that decision is also functional in that it represents danger of the unknown, which provides information that may serve to prevent or alter the behaviour. Perhaps the water will be explored first or a shorter jump will be made. In a typically developing individual, learning often lays down a set of adaptive emotional responses that are useful in regulating behaviour.

This reasoning is consistent with the Somatic Marker Hypothesis (Bechara & Damasio, 2005; Damasio et al., 1996) according to which individuals learn to associate feelings with objects, events and outcomes. The feelings guide decision-making processes because they provide cues to the decision-maker about whether to approach or avoid a given choice option based on prior experience. For example, over a period of learning, these cues signal to people who are playing gambles which card decks are more likely to pay-off with winnings and which card decks are more likely to lead to losses (i.e. the Iowa Gambling Task, IGT; Bechara, Damasio, Tranel, & Damasio, 1997). Somatic markers are shown to be represented in the ventromedial prefrontal cortex (vmPFC) and the amygdala. The learning function is supported by the finding that vmPFC lesions inhibit learning about gains and losses, which consequently leads to poorer gambling decisions (Bechara et al., 1997).

Our argument expands upon the empirical evidence from Bechara and colleagues just reviewed (Bechara & Damasio, 2005; Bechara et al., 1997) to suggest that peripheral emotional responses, such as facial expressions, also guide the decision-making process and that disrupting even one physiological input can affect decision-making.

Feedback from facial expressions is one important emotional input with consequences for decision-making. Indeed, research has shown that blocking facial mimicry impairs the recognition and categorisation of facial expressions (Maringer, Krumhuber, Fischer, & Niedenthal, 2011; Oberman, Winkielman, & Ramachandran, 2007), suppressing the facial expression of emotions increases physiological arousal (Gross & Levenson, 1993), and maintaining positive facial expressions during stressful situations has both physiological and psychological benefits (Kraft & Pressman, 2012). Specifically, within the realm of decision-making, recent evidence has suggested that near-wins and near-losses lead to physiological responses, including activation of facial musculature (Wu, van Dijk, & Clark, 2015).

These various findings suggest that a failure to represent the emotional meaning of choice options can lead to reductions in decision quality. However, research has yet to determine whether inhibiting emotional inputs from the periphery affects decisions during the action of making the decision. We specifically propose that emotional responses (such as facial expressions and physiological arousal) guide the decision-making process and we provide some evidence that disrupting even a single physiological input (such as one's ability to generate facial expressions) can alter decision-making.

We recently investigated the consequences of inhibiting facial feedback during a standard risky decision task (Carpenter and Niedenthal, 2017). Examining risk is especially interesting in the context of theorising about health decisions because health decisions contain uncertainty about the potential costs (losses) that may be incurred from making the decision, which is often a feature of risky decisions (see Yates & Stone, 1992; for a review). In our investigation, we employed the Balloon Analogue Risk Task (BART; Lejuez et al., 2002). This task involves a series of trials on which participants see a balloon depicted on a computer screen and press a button to inflate the balloon as many times as they choose. The number of pumps that participants apply without popping the balloon is then converted into small amounts of real money. If the balloon is inflated to the point of popping, participants lose points on that trial. Balloons pop at random intervals, such that participants cannot learn a rule for successfully inflating the balloon. This makes each trial equally uncertain and therefore fear-eliciting. In the BART, more pumps are assumed to represent greater risk behaviour as each pump increases the probability that the balloon will pop and points will be lost.

In a pilot demonstration, we found that people make negative facial expressions of fear when performing the BART, as if they are afraid that their next action will pop the balloon and result in a loss. From the present perspective, making the facial expression is a component of the partial simulation of fear that serves to represent the functional meaning of the risk to the individual (Wood, Rychlowska, Korb, & Niedenthal, 2016). The inhibition of fear expressions, we reasoned, would lead people to make riskier decisions because the uncertainty inherent in the risk would not be indicated by fearful expressions. In the main study, we applied stiff and inflexible medical tape to some participants' foreheads in order to inhibit activation of the corrugator muscle (which controls movement of the forehead and eyebrow), and instructed them to insert a mouth guard to inhibit activation of the muscles around the mouth). Control participants received tape to their temples in a way that did not affect activation of muscles involved in facial expressions. All participants then performed the standard BART. Consistent with predictions, we found that inhibiting the activation of the facial muscles

used in expressing fear led to riskier decisions, as compared to the control participants who did not experience inhibited activation of these facial muscles.

The structure of the BART task is not dissimilar to the type of decision made in the context of health decisions. When making a health decision, for example, individuals may have to decide whether or not to accept treatment for a condition, or how much of a treatment to undertake. We propose that due to patients' own past experience and learning, some decision problems, and especially those that involve uncertainty and risk, will be more fear-inducing than others. Importantly, the health context may itself involve compromises to emotional responding. Numerous diseases and neurological conditions affect facial muscles and feedback (e.g. Bell's Palsy, Parkinson's Disease, Ramsay-Hunt Syndrome, Multiple Sclerosis, Guillain-Barré syndrome, stroke, injuries and advanced diabetes), and these may introduce an inherent disruption to decision-making. Specifically, we predict that because patients suffering from facial paralysis also experience a loss of feedback about emotions, which would typically be elicited by the action of making a decision, their decision-making is sometimes compromised.

Note that the use of action-related emotions in decision-making is different from the influence of incidental emotional states, such as background mood, on decision-making (cf. Schlosser et al., 2014; Schlösser et al., 2013). Emotions that are detached from the objects or events under consideration may not be useful, and in fact may compromise decision-making. For instance, transient feelings or mood states can be misattributed to a stimulus that did not cause the feelings in the first place, and the misattribution can inappropriately determine decisions about that stimulus (Schwarz & Clore, 2003). This occurs when a person in a bad mood due to poor weather conditions generates a negative judgement about a person or other event that they encounter on the same day. These effects occur despite the fact that the weather should have no bearing on the evaluation of the unrelated stimulus.

In the area of health decision-making, incidental emotions, such as anger, may often arise because of reactions to factors like the medical diagnosis itself. In the likely circumstance that the diagnosis elicits an emotion like fear or anger, this has the potential to influence the treatment risk decision. Such specific incidental emotions have indeed been found to be reliably associated with risk taking. As described earlier, when feeling fear people are less likely to take risks (Lerner & Keltner, 2001), whereas when feeling happy or angry, people are more likely to take risks (Bateman, Dent, Peters, Slovic, & Starmer, 2007; Lerner & Keltner, 2001). These differences are often due to the ways in which incidental emotions guide the perceived probability of different consequences from risk taking (Slovic, Finucane, Peters, & MacGregor, 2004).

While specific incidental emotions are an important factor in understanding risky health decisions and this topic would be apt for future discussions, our approach is focused on how the difficulty of the decisions themselves may be the source of affect, especially stress and related negative feelings of fear or anxiety. Moreover, although risky decisions make up one portion of health decisions, many other choices are more complicated than simply deciding whether or not to engage in a certain behaviour. As described earlier, complex decisions often involve tradeoffs between both positive and negative attributes. Thus, from our perspective it is also important to understand how the management of emotions that arise from the process of making difficult multiattribute decisions influences patient behaviour. We present a framework for conceptualising this process in Part II.

Part II: managing emotional inputs during difficult multiattribute decisions

We have proposed that emotional inputs are important to health decision-making because they signal information about the meaning of the choice options for the individual. There are, however, cases where the emotion is especially intense and may overwhelm the person and consequently hinder decision-making. For instance, stress responses induced from unrelated stressors (e.g. speech tasks, electric shocks, time pressure) have been shown to incidentally disrupt the learning of choice contingencies (Preston, Buchanan, Stansfield, & Bechara, 2007), increase decision biases (Kassam, Koslov, & Mendes, 2009), and lead to less systematic decision-making (Keinan, Friedland, & Ben-Porath, 1987).

One model of stress, known as the biopsychosocial model (BPSM) categorises stress as either threatening or challenging (cf. Blascovich, 2013; Blascovich & Tomaka, 1996; Kassam et al., 2009). A threat stress response occurs when a person perceives that he or she lacks the resources necessary to complete a given task, and this is associated with inefficient cardiovascular responding. A challenge stress response, on the other hand, occurs when an individual perceives that the necessary resources are available, and is marked by more efficient cardiovascular responding (Blascovich, 2013; Blascovich & Tomaka, 1996; Kassam et al., 2009). In the realm of decision-making, threat stress has been shown to have disruptive effects on decision-making through increasing decision biases, whereas challenge stress has been shown to decrease these effects (Kassam et al., 2009).

The literature reviewed thus far has focused on how stress reactions to unrelated events or environmental stimuli influence decision-making. However, is it plausible that a difficult decision, particularly one that involves complicated multiattribute trade-offs, is capable of eliciting a stress response. Related research on physiological responding during decision-making has shown that people exhibit more physiological reactivity when making judgments about novel stimuli than when they undergo an attitude-rehearsal procedure (Blascovich et al., 1993). This suggests that novel decisions may be especially likely to generate an affective, and even stress, response. Patients are often faced with the task of making unfamiliar or novel decisions, and thus health decisions provide an important context in which to explore the possible implications of stress responses to multiattribute decisions.

The ability to manage any emotions experienced from multiattribute decisions is especially important to health decision-making because such decision situations typically involve trade-offs among several attributes. Returning to our earlier example of Crohn's disease treatment, patients facing this decision must make a trade-off between two treatment options that contain multiple attributes (i.e. features) in conflict with each other that are multiattribute in nature. Option 1: The biologic therapy is more effective at treating Crohn's disease, but it suppresses the immune system and leads to a higher likelihood of complications like infections and cancer. Option 2: The non-biologic therapy is less effective at treating Crohn's disease, but it does not suppress the immune system and has a lower likelihood of complications from infections and cancer. In this case, the decision-maker must weigh the efficacy of the therapy for treating Crohn's disease against the likelihood that the treatment will suppress the immune system and lead to other complications. While emotional reactions likely factor into these types of complicated trade-offs, the existing research on multiattribute decisions has largely taken a

cognitive approach to understanding the psychological processes underlying these types of choices (c.f., Simon, Krawczyk, & Holyoak, 2004; Timmermans, 1993).

For example, research has shown that with an increasing number of choice alternatives people become more likely to evaluate fewer attributes and instead use an 'absolute dimensional approach' to making the decision, whereby they compare an attribute to some absolute standard that they set (Timmermans, 1993). Alternatives with attribute (s) that meet the absolute standard are more likely to be chosen. Other work on multiattribute decisions, reviewed in this section, has been concerned with how people change their attitudes about attributes, or their importance weights and desirability ratings of the attributes, either pre- or post-choice, in order to make the decision process easier.

The decision process can be divided into the pre-decision phase, or the time that occurs before an individual commits to a choice, and into the post-decision phase, or the time that occurs after an individual has committed to a choice. Much extant work has been concerned with what happens during or immediately following the decision. For example, one important literature has focused on a phenomenon known as cognitive dissonance reduction through the spreading of alternatives. This phenomenon refers to the fact that after people make a decision they change their attitudes to be more positive towards the attributes (features) in whatever option they end up choosing, and change their attitudes to be more negative toward the attributes (features) in whatever option they end up rejecting (Croyle & Cooper, 1983; Festinger, 1957, 1962; Jarcho, Berkman, & Lieberman, 2011). For example, if a Crohn's disease patient has chosen biologic therapy over non-biologic therapy, they will report a very positive attitude towards a more successful treatment of Crohn's disease, and a less negative attitude towards the suppression of their immune system and the increased likelihood of potential negative consequences. On the other hand, when evaluating the rejected non-biologic option, the person will report a very negative attitude towards a less successful treatment, and a less positive attitude towards the idea of their immune system not being suppressed. The majority of this work on cognitive dissonance reduction has focused on how people change their attitudes post-choice as a way to justify the decision that they have already committed to making.

Research on pre-decisional coherence shifting (Carpenter et al., 2016; Meloy, Russo, & Miller, 2006; Simon et al., 2004), however, has suggested that the change in how people evaluate the dimensional importance and desirability of attributes in choice options begins before a decision has been made. Although originally thought of as a more cold, cognitive process (Simon et al., 2004), or a cognitive process that may also involve the maintenance of a positive mood state (Meloy et al., 2006), recent work has begun to examine the affective and physiological factors underlying these pre-decisional value shifts (Carpenter et al., 2016).

Specifically, Carpenter and colleagues found that people who exhibit increased sympathetic nervous system activation, indexed by increases in skin conductance responses (SCRs), are less likely to engage in pre-decisional coherence shifting behaviours and self-report the decision as being more difficult (Carpenter et al., 2016). The same pattern of disrupted pre-decisional coherence shifting was found among people depleted of regulatory resources (Carpenter et al., 2016). This work also indicated that greater attribute conflict leads people to self-report more negative feelings related to stress, anxiety and discomfort, and suggests that pre-decisional coherence shifting functions as a way for individuals to regulate this negative affect and the physiological arousal associated

with making a difficult multiattribute decision. Importantly, this arousal regulation has the potential to occur well before a choice commitment has been made, unlike post-decision cognitive dissonance where the reductions in physiological arousal are typically thought to occur during or after the decision commitment (Croyle & Cooper, 1983; Jarcho et al., 2011).

The pre-decisional value change work suggests not only that multiattribute decisions are difficult, but also that they generate physiological arousal and negative affect even before a decision has been made (Carpenter et al., 2016). In these cases, it becomes critical for the individual encountering difficult multiattribute decisions to be able to manage physiological inputs so that they can make it through the decision and commit to a choice. This is not to say that pre-decisional coherence shifting necessarily always functions as an optimal decision strategy. There are likely circumstances where shifting one's values in order to more easily navigate a decision could lead to worse, and even sub-optimal, post-choice outcomes. As such, the existing literature on this topic (Carpenter et al., 2016) simply suggests that pre-decisional coherence shifting functions generally as a regulatory strategy that aids people in coping with the distress generated by attribute conflict in multiattribute decisions.

The present approach seeks to integrate and extend the existing literatures on stress and multiattribute decision-making to propose that difficult multiattribute decisions are capable of generating a stress response that, if left unmanaged, is disruptive to the decision process. Here, health decisions are focused on as an especially relevant context in which to develop these ideas. We specifically propose that when patients are confronted with major multiattribute health decisions this has the potential to generate a negative affective reaction, such as a stress response. If patients are able to manage the stress response in the pre-decision phase of the choice through changing their attitudes and values (i.e. importance weights and desirability ratings) before committing to a choice, this is likely to reduce the decision difficulty and have predictable consequences for their physiology.

We further propose that patient decision-making will be linked to both short- and long-term stress responses. As described above, pre-decisional coherence shifting (through changes in attribute desirability or importance) is associated with reductions in physiological arousal (Carpenter et al., 2016). In contrast, a failure to coherence shift is associated with greater physiological arousal responses and with a self-reported difficulty with making a decision (Carpenter et al., 2016). We thus argue that the shifting of values through the process of managing physiological arousal in multiattribute decisions plausibly affects not only the feelings patients experience when they are confronted with multiattribute health decisions, but may also have long-term consequences for how satisfied the individual is with the decision outcome. Returning to our patient example, when a Crohn's disease patient is facing the choice of a biologic vs. a non-biologic treatment, the patient might initially state that they value (e.g. find important and desirable) both an effective treatment and a treatment with a lower likelihood of side effects. Given that the biologic therapy is more effective, but has a higher likelihood of side effects than the non-biologic therapy, this decision will generate some stress because the patient realises that either way they are giving up something that they value (e.g. either the effectiveness of the treatment or the reduced likelihood of side effects). If the stress that they experience is too great, the patient will be overwhelmed by the decision, defer making the decision, or even choose to not seek any treatment.

Doing so could be detrimental to their post-choice satisfaction and overall well-being. If, however, the patient is able to reduce the stress they experience from this decision problem by, for example, deciding that they believe an effective treatment is more important than the risk of side effects, we argue that this could lead the patient to more easily make the decision, and to plausibly feel more satisfied with their choice.

Returning to the literature on threat and challenge stress responses (cf. Blascovich, 2013; Blascovich & Tomaka, 1996; Kassam et al., 2009), it is plausible that threat stress responses will be especially disruptive when the decision task is perceived to exceed the cognitive resources necessary to make the decision. If perceived as threatening, we argue that a decision can be a negatively arousing experience. We further theorise that patients will encounter similar stress responses when facing a novel and difficult multiattribute health decision that involves attribute conflict, and that how the physiological inputs are managed will have important consequences for both long- and short-term physiology and well-being.

Specifically, we propose that short-term stress responses are related to the extent to which an individual can make a decision. In other words, how easily the patient can make a decision and how well the patient can manage the affective responses generated by the decision problem itself. For example, if patients faced with the multiattribute Crohn's disease problem believe that they do not have the resources to effectively make the decision, perhaps because they feel overwhelmed by the trade-off between a biologic treatment option that has a greater likelihood of side effects and a non-biologic option that is not as effective, they will plausibly experience threat stress. Such stress should interfere with the ability to adjust their values to simplify the decision (e.g. they will be unable to change their evaluations and will struggle with the conflicting appraisal that both the risk of side effects and the efficacy of the treatment option are highly important). Consistent with extant literature on threat stress and decision-making (cf. Kassam et al., 2009), we also predict that patients experiencing threat stress will show less efficient physiological responding, including decreased cardiac output and increased vascular reactivity.

On the other hand, if patients facing a difficult multiattribute Crohn's disease treatment decision believe they have the resources to make this choice, they are likely to experience challenge stress. When stress is experienced as challenging, patients should more readily adjust their values to simplify the decision (e.g. change their evaluations so that either the risk of side effects or the efficacy of the treatment will become less important). Also consistent with extant literature (Kassam et al., 2009), we predict that patients experiencing challenge stress would show more efficient physiological responding, including increased cardiac output and decreased vascular reactivity.

Threat stress could also be a consequence of the unsuccessful resolution of attribute conflict in multiattribute decision-making. That is, stress may not only be elicited when a person is initially faced with a multiattribute decision problem, but the process of being unable to resolve that conflict could also generate stress and less efficient physiological responding post-choice. Importantly, if threat stress is generated post-choice because attribute conflict was not resolved, it will likely also cause disruptions when the individual is faced with other multiattribute decisions, potentially resulting in a cycle of longer term stress-responses.

We specifically argue that longer term, or more chronic, stress-responses are also linked to how people manage emotions in difficult multiattribute decision contexts.

Expanding upon our predictions described above, individuals who respond to difficult multiattribute decision contexts with a threat stress response should show similar kinds of responding to other difficult choice problems across their lives. Repeated threat stress responses to decision problems would likely lead to long-term negative health consequences, such as chronically elevated levels of cortisol, a greater incidence of health conditions, and lower self-reported well-being.

While the physiological focus in this section has thus far been on activation of the sympathetic nervous system, patient health outcomes are also related to differences in physiological responding of the parasympathetic nervous system (Kassam et al., 2009; Muhtadie, Koslov, Akinola, & Mendes, 2015). Recent theorists have linked activity in the parasympathetic nervous system to the experience of emotion, as well as to the appropriate regulation of social and emotional behaviours (Porges, 2007, 2009). The vagus nerve is particularly important to stress responding, as parasympathetic influence on the heart via the vagus nerve leads to high-frequency variation in the heart's rhythm (Porges, 2007) and can be reliably approximated by respiratory sinus arrhythmia (RSA). Decreases in parasympathetic activity in response to cognitive or attentional challenge have been recently termed as 'vagal flexibility' (Muhtadie et al., 2015, p. 3). Work examining vagal flexibility shows that people with greater vagal flexibility (i.e. greater decreases in parasympathetic activity) show faster physiological recovery from a psychological stressor (Muhtadie et al., 2015). Furthermore, Kassam et al. (2009) found that decreases in parasympathetic activity (as assessed by changes in RSA) were associated with fewer adjustment errors in typical anchoring and adjustment decision bias paradigms, regardless of stress condition. These findings suggest that individuals who exhibit greater vagal flexibility may also have more adaptive biological responses in stressful decision-making contexts and therefore make better decisions.

The ability to regulate negative emotion and physiological arousal during decision-making has been found to be important both pre-decision through coherence shifting (Carpenter et al., 2016) and post-decision through cognitive dissonance reduction processes (Croyle & Cooper, 1983). Through the process of changing their attitudes and values about a decision, either before or after making a difficult choice, decision-makers are able to reduce perceived decision difficulty and negative arousal associated with making that choice (Carpenter et al., 2016; Croyle & Cooper, 1983). Recent evidence has also suggested that vagally mediated heart rate variability is associated with greater emotion regulation ability (Williams et al., 2015). Given that vagal flexibility is associated with greater emotion regulation and emotion regulation strategies have been implicated in reducing decision difficulty (Carpenter et al., 2016), it is plausible that those with greater vagal flexibility will also exhibit decision strategies used to regulate emotion and physiological arousal during difficult decision-making.

Thus, in much the same way that individuals with greater vagal flexibility have been shown to better regulate social and emotional situations, we propose that individuals with greater vagal flexibility will be able to more effectively regulate the aversive emotions and physiological arousal generated by difficult multiattribute decisions. When making stressful health decisions, we propose that individuals with greater flexibility in vagal activity will perceive less difficulty with making important decisions, and that these perceptions will be associated with better long-term health outcomes. Specifically, when a person faces a difficult multiattribute decision, those with greater vagal flexibility are predicted to self-report less decision difficulty, and exhibit

decreased indecisiveness, less negative affect in response to the decision problem, and less physiological arousal across the decision process. We argue that people with greater vagal flexibility should be more likely to change their values to be consistent with an eventually chosen option, and may also have an easier time justifying the reasons for making their decisions.

Understanding how patients may have different affective reactions to difficult multiattribute decisions is important for helping patients navigate decision problems, and also feel satisfied with whatever choices they make. Knowing that patients may view a difficult multiattribute choice as threatening can allow for the use of strategies that will help them overcome or reappraise their decision stress in a manner that leads to better physiological and psychological outcomes. Research on reappraisal of stressful information indicates that people can be trained through simple manipulations to reconstrue threat stress reactions into challenge stress reactions (Jamieson, Nock, & Mendes, 2012). Thus, these insights may be especially helpful for decision aiding procedures, where changing the way that patients think and feel about the decision context will presumably allow them to overcome some of their hesitations with both the decision aiding procedures and with approaching the decision problem in general.

Conclusion

In this article, we reviewed the literature on health decision-making and emotional processing, and proposed the idea that the flexible use and management of emotions across different physiological inputs influences the way that patient decisions are made. We argued that in some cases it is necessary for individuals to use emotional responses as relevant content in order to more effectively make decisions. We also attempted to clarify why emotional responses are important to the decision-making process itself, and provided a theoretical account of how the management of emotional inputs influences multiattribute decisions.

Specifically, in Part I, this article extends the work of Bechara and Damasio (Bechara & Damasio, 2005; Bechara et al., 1997; Damasio et al., 1996) that demonstrates how vmPFC activation is associated with emotional learning about decisions to propose that feedback from peripheral emotional responses (including facial expressions) is also influential to the decision-making process. We argue that feedback from emotions generated by the action of making a decision provide information for the decision-maker about whether or not to take, for example, a risk in a given decision situation. When feedback from the periphery is inhibited this has the consequence of altering decision-making in systematic and predictable ways.

In Part II of this article, we propose that difficult multiattribute decisions involving trade-offs generate a negative stress response, which if left unmanaged will disrupt decision-making. Integrating evidence from the multiattribute decision-making and stress literatures, we argue that individuals who do not perceive that they have the resources available to regulate the stress generated from making a multiattribute decision are likely to experience a threat stress response that will be disruptive to the decision process. Other decision-makers, however, who are able to appropriately regulate this negative response will have better physiological and decision outcomes. The theoretical account developed here thus highlights the importance of managing some of the physiological components of emotion to prevent the system from becoming overwhelmed.

Additionally, we propose that vagal flexibility is likely linked to decision-making through a proposed association both with greater health outcomes in the long term, as well as with the ability to make more effective decisions in the moment. Throughout our theoretical account we also pointed to implications that our predictions have for both clinical and non-clinical populations of decision-makers.

We believe that our integration of previous and on-going research will generate novel, testable ideas that can be used by researchers in developing decision aids and shared patient–practitioner decision procedures that benefit health decision-making processes. Our theoretical approach thus contributes to the understanding of patient-centred emotional decision processes and can also inform future research on decision aiding and shared decision-making.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the National Institute of Mental Health of the National Institutes of Health under Award [T32MH018931].

References

Bateman, I., Dent, S., Peters, E., Slovic, P., & Starmer, C. (2007). The affect heuristic and the attractiveness of simple gambles. *Journal of Behavioral Decision Making, 20*, 365–380.

Bechara, A., & Damasio, A. R. (2005). The somatic marker hypothesis: A neural theory of economic decision. *Games and Economic Behavior, 52*, 336–372.

Bechara, A., Damasio, H., Tranel, D., & Damasio, A. R. (1997). Deciding advantageously before knowing the advantageous strategy. *Science, 275*, 1293–1295.

Blascovich, J. (2013). The biopsychosocial model of challenge and threat: Reflections, theoretical ubiquity, and new directions. *Neuroscience of prejudice and intergroup relations* (p. 229). New York, NY: Psychology Press.

Blascovich, J., Ernst, J. M., Tomaka, J., Kelsey, R. M., Salomon, K. L., & Fazio, R. H. (1993). Attitude accessibility as a moderator of autonomic reactivity during decision making. *Journal of Personality and Social Psychology, 64*, 165–176.

Blascovich, J., & Tomaka, J. (1996). The biopsychosocial model of arousal regulation. *Advances in Experimental Social Psychology, 28*, 1–51.

Carpenter, S. M., & Niedenthal, P. M. (2017). *Inhibiting facial action increases risk taking*. Manuscript Submitted for Publication.

Carpenter, S. M., Yates, J. F., Preston, S. D., & Chen, L. (2016). Regulating emotions during difficult multiattribute decision making: The role of pre-decisional coherence shifting. *PLoS ONE, 11*, e0150873.

Castellano, G., Kessous, L., & Caridakis, G. (2008). Emotion recognition through multiple modalities: Face, body gesture, speech. In C. Peter, & R. Beale (Eds.), *Affect and emotion in human-computer interaction* (pp. 92–103). Berlin: Springer.

Croyle, R. T., & Cooper, J. (1983). Dissonance arousal: Physiological evidence. *Journal of Personality and Social Psychology, 45*, 782–791.

Damasio, A. R., Everitt, B. J., & Bishop, D. (1996). The somatic marker hypothesis and the possible functions of the prefrontal cortex [and discussion]. *Philosophical Transactions of the Royal Society B: Biological Sciences, 351*, 1413–1420.

Dunning, D., Fetchenhauer, D., & Schlosser, T. (2017). *The varying roles played by emotion in economic decision making*. Manuscript Submitted for Publication.

Ekman, P. (2004). Emotional and conversational nonverbal signals. In J. M. Larrazabal, & L. A. Perez Miranda (Eds.), *Language, knowledge, and representation* (pp. 39–50). Dordrechtc: Springer.

Engelen, A., Vanderhaegen, J., Van Poppel, H., & Van Audenhove, C. (2016). Patients' views on using decision support tools: A systematic review. *European Journal for Person Centered Healthcare, 4*, 61–186.

Festinger, L. (1957). *A theory of cognitive dissonance*. Stanford: Stanford University Press.

Festinger, L. (1962). Cognitive dissonance. *Scientific American, 207*, 93–106.

Gilbert, D. T., & Ebert, J. E. J. (2002). Decisions and revisions: The affective forecasting of changeable outcomes. *Journal of Personality and Social Psychology, 82*, 503–514.

Gross, J. J., & Levenson, R. W. (1993). Emotional suppression: Physiology, self-report, and expressive behavior. *Journal of Personality and Social Psychology, 64*, 970.

Hsee, C. K., & Hastie, R. (2006). Decision and experience: Why don't we choose what makes us happy? *Trends in Cognitive Sciences, 10*, 31–37.

Jamieson, J. P., Nock, M. K., & Mendes, W. B. (2012). Mind over matter: Reappraising arousal improves cardiovascular and cognitive responses to stress. *Journal of Experimental Psychology: General, 141*, 417–422.

Jarcho, J. M., Berkman, E. T., & Lieberman, M. D. (2011). The neural basis of rationalization: Cognitive dissonance reduction during decision-making. *Social Cognitive and Affective Neuroscience, 6*, 460–467.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica, 47*, 263–292.

Kahneman, D., & Tversky, A. (1984). Choices, values, and frames. *American Psychologist, 39*, 341–350.

Kassam, K. S., Koslov, K., & Mendes, W. B. (2009). Decisions under distress: Stress profiles influence anchoring and adjustment. *Psychological Science, 20*, 1394–1399.

Keinan, G., Friedland, N., & Ben-Porath, Y. (1987). Decision making under stress: Scanning of alternatives under physical threat. *Acta Psychologica, 64*, 219–228.

Kraft, T. L., & Pressman, S. D. (2012). Grin and bear it the influence of manipulated facial expression on the stress response. *Psychological Science, 23*, 1372–1378.

Lejuez, C. W., Read, J. P., Kahler, C. W., Richards, J. B., Ramsey, S. E., Stuart, G. L., … Brown, R. A. (2002). Evaluation of a behavioral measure of risk taking: The Balloon Analogue Risk Task (BART). *Journal of Experimental Psychology: Applied, 8*, 75–84.

Lerner, J. S., & Keltner, D. (2001). Fear, anger, and risk. *Journal of Personality and Social Psychology, 81*, 146–159.

Lerner, J. S., Li, Y., Valdesolo, P., & Kassam, K. S. (2015). Emotion and decision making. *Annual Review of Psychology, 66*, 799–823.

Lin, G. A., & Fagerlin, A. (2014). Shared decision making: State of the science. *Circulation: Cardiovascular Quality and Outcomes, 7*, 328–334.

Malloy-Weir, L. J., Schwartz, L., Yost, J., & McKibbon, K. A. (2016). Empirical relationships between numeracy and treatment decision making: A scoping review of the literature. *Patient Education and Counseling, 99*, 310–325.

Maringer, M., Krumhuber, E. G., Fischer, A. H., & Niedenthal, P. M. (2011). Beyond smile dynamics: Mimicry and beliefs in judgments of smiles. *Emotion, 11*, 181–187.

Muhtadie, L., Koslov, K., Akinola, M., & Mendes, W. B. (2015). Vagal flexibility: A physiological predictor of social sensitivity. *Journal of Personality and Social Psychology, 109*, 106–120.

Meloy, M. G., Russo, J. E., & Miller, E. G. (2006). Monetary incentives and mood. *Journal of Marketing Research, 43*, 267–275.

Novemsky, N., Dhar, R., Schwarz, N., & Simonson, I. (2007). Preference fluency in choice. *Journal of Marketing Research, 44*, 347–356.

Oberman, L. M., Winkielman, P., & Ramachandran, V. S. (2007). Face to face: Blocking facial mimicry can selectively impair recognition of emotional expressions. *Social Neuroscience, 2*, 167–178.

Peters, E., Hibbard, J., Slovic, P., & Dieckmann, N. (2007). Numeracy skill and the communication, comprehension, and use of risk-benefit information. *Health Affairs, 26*, 741–748.

Peters, E., Vastfjall, D., Slovic, P., Mertz, C. K., Mazzocco, K., & Dickert, S. (2006). Numeracy and decision making. *Psychological Science, 17*, 407–413.

Porges, S. W. (2007). The polyvagal perspective. *Biological Psychology, 74*, 116–143.

Porges, S. W. (2009). The polyvagal theory: New insights into adaptive reactions of the autonomic nervous system. *Cleveland Clinic Journal of Medicine, 76*, S86–S90. Retrieved from http://doi.org/10.3949/ccjm.76.s2.17

Preston, S. D., Buchanan, T. W., Stansfield, R. B., & Bechara, A. (2007). Effects of anticipatory stress on decision making in a gambling task. *Behavioral Neuroscience, 121*, 257–263.

Rothman, A. J., Bartels, R. D., Wlaschin, J., & Salovey, P. (2006). The strategic use of gain- and loss-framed messages to promote healthy behavior: How theory can inform practice. *Journal of Communication, 56*, S202–S220.

Schwarz, N., & Clore, G. L. (2003). Mood as information: 20 years later. *Psychological Inquiry, 14*, 296–303.

Schlösser, T., Dunning, D., & Fetchenhauer, D. (2013). What a feeling: The Role of immediate and anticipated emotions in risky decisions. *Journal of Behavioral Decision Making, 26*, 13–30.

Schlosser, T., Fetchenhauer, D., & Dunning, D. (2014). Trust against all odds? Emotional dynamics in trust behavior. *Decision*. Retrieved from http:// dx.doi.org/10.1037/dec0000048

Simon, D., Krawczyk, D. C., & Holyoak, K. J. (2004). Construction of preferences by constraint satisfaction. *Psychological Science, 15*, 331–336.

Singer, E., Couper, M. P., Fagerlin, A., Fowler, F. J., Levin, C. A., Ubel, P. A., … Zikmund-Fisher, B. J. (2014). The role of perceived benefits and costs in patients' medical decisions. *Health Expectations, 17*, 4–14.

Slovic, P., Finucane, M. L., Peters, E., & MacGregor, D. G. (2004). Risk as analysis and risk as feelings: Some thoughts and affect, reason, risk, and rationality. *Risk Analysis: An International Journal, 24*, 311–322.

Smith, C. A., & Ellsworth, P. C. (1985). Patterns of cognitive appraisal in emotion. *Journal of Personality and Social Psychology, 48*, 813–838.

Song, H., & Schwarz, N. (2008). Fluency and the detection of misleading questions: Low processing fluency attenuates the moses illusion. *Social Cognition, 26*, 791–799.

Timmermans, D. (1993). The impact of task complexity on information use in multi-attribute decision making. *Journal of Behavioral Decision Making, 6*, 95–111.

Ubel, P. A., Loewenstein, G., Schwarz, N., & Smith, D. (2005). Misimagining the unimaginable: The disability paradox and health care decision making. *Health Psychology, 24*, S57–S62.

Williams, D. P., Cash, C., Rankin, C., Bernardi, A., Koenig, J., & Thayer, J. F. (2015). Resting heart rate variability predicts self-reported difficulties in emotion regulation: A focus on different facets of emotion regulation. *Frontiers in Psychology, 6*, 261.

Wilson, T. D., & Gilbert, D. T. (2005). Affective forecasting and knowing what to want. *Current Directions in Psychological Science, 14*, 131–134.

Winkielman, P., Schwarz, N., Fazendeiro, T., & Reber, R. (2003). The hedonic marking of processing fluency: Implications for evaluative judgment. In J. Musch & K. C. Klauer (Eds.), *The psychology of evaluation: Affective processes in cognition and emotion* (pp. 189–217). Mahwah, NJ: Laurence Erlbaum Associates.

Wood, A., Rychlowska, M., Korb, S., & Niedenthal, P. (2016). Fashioning the face: Sensorimotor simulation contributes to facial expression recognition. *Trends in Cognitive Sciences, 20*, 227–240.

Wu, Y., van Dijk, E., & Clark, L. (2015). Near-wins and near-losses in gambling: A behavioral and facial EMG study. *Psychophysiology, 52*, 359–366.

Yates, J. P., & Stone, E. R. (1992). The risk construct. In J. P. Yates (Ed.), *Risk-taking behavior* (pp. 1–25). Oxford: John Wiley & Sons.

Yates, J. F., Veinott, E. S., & Patalano, A. L. (2003). Hard decisions, bad decisions: On decision quality and decision aiding. In S. L. Schneider & J. C. Shanteau (Eds.), *Emerging perspectives on judgment and decision research* (pp. 13–63). New York, NY: Cambridge University Press.

Zikmund-Fisher, B. J., Sarr, B., Fagerlin, A., & Ubel, P. A. (2006). A matter of perspective: Choosing for others differs from choosing for yourself in making treatment decisions. *Journal of General Internal Medicine, 21*, 618–622.